Resource Action: EWG-19A **Task Force Recommendation Category:** 2

Modify or Reconstruct Benches in the Feather River Channel to Enhance Spawning and Rearing Habitat

Date of Field Evaluation: No field evaluation has been conducted

Evaluation Team: Richard Harris, Koll Buer, and Bruce Ross

Description of Proposed Resource Action Measure:
To modify existing floodplain deposits or build vegetated "benches" at various stage elevations in the lower Feather River (i.e., near Verona) to enhance splittail spawning habitat and Chinook salmon rearing habitat.

Resource Actions that are either similar to or directly related to the proposed measure:

- EWG-22, that would attempt to improve connectivity of the river with its floodplain in the lower Feather River by setting levees back.
- EWG-16A and EWG-16B, which propose enhancement of existing, or creation of new side channel habitat in the Feather River.
- EWG-17 and EWG-51, which are intended to enhance or restore riparian habitat.

Nexus to Project:
A variety of factors including levee construction, hydraulic mining, agricultural and urban development have contributed to the degradation of aquatic habitat in the lower Feather River. The project contributes to these effects by regulating flows and preventing downstream sediment recruitment. This measure would attempt to restore floodplain functions through modification or creation of instream deposits.

Potential Environmental Benefits:
As proposed, this measure could increase the topographic diversity of the lower Feather River within the confines of existing levees. That would be achieved through either the modification of existing geomorphic surfaces or through the creation of new ones. Increased topographic diversity in turn, would increase habitat diversity and benefit targeted fish species, including splittail and Chinook salmon. It could also potentially serve to improve conditions for the recruitment and development of riparian vegetation. Improving riparian conditions would benefit wildlife that depend on this type of habitat.

Potential Constraints:
The principal constraint to effectiveness will be the prescribed flow regime. Unless a complementary flow regime is implemented, the created or modified topographic surfaces will not function as habitat. Secondary constraints include the availability of substrate with which to create surfaces and the potential short-term water quality impacts of in-channel construction.

Existing Conditions in the Proposed Resource Action Implementation Area:
The lower Feather River (especially below Gridley) is presently incised well below its former floodplain (10-25 feet). Studies conducted by DWR indicate that the Rosgen classification for the lower Feather River is "entrenched, F channel type." Prior to the placement of levees, hydraulic mining, and subsequent downcutting, the lower Feather River was a meandering C channel type, comparable to the Sacramento River and other streams draining to the Central Valley. At intervals of approximately 1-2 years it would have experienced overbank flooding onto its adjacent floodplain. At the present time, only floods in excess of approximately 50,000 cubic feet per second (cfs) would cause flooding out of the entrenched channel. These have occurred about a dozen times over the past 40 years. High magnitude flooding events (>100,000 cfs) have occurred three times, in 1965, 1986, and 1997.

Alluvial streams typically have well-developed sequences of alternating bars. Currently, the lower Feather River generally does not possess these attributes, or many of the other characteristics of an alluvial river in dynamic equilibrium.

Under Study Plan, SP-G2, the geomorphic reaches in the lower Feather River have been categorized. From Feather River Mile (RM) 59 (Thermalito) to RM 0 (Sacramento confluence) eight reaches were defined. Two sections (RM 39 to RM 54 and RM 34 to RM 35.5) presently have a high degree of instream geomorphic diversity (i.e., islands, bars). They also have moderate to high sinuosity with well-developed point bars. The substrate in RM 39 to RM 54 is gravel, and at RM 34 to RM 35.5, it is sand and gravel. In both areas, levees are well set back from the stream on at least one side of the channel.

For the remainder of the lower Feather River, the channel cross section is roughly trapezoidal, the channel is relatively wide, and there are relatively few floodplain surfaces. Those surfaces that do exist are mostly sand substrate, and the channel bottom itself is predominately heavy clay, which may not be suitable for salmonid rearing habitat or splittail spawning habitat.

Most existing deposits within the incised channel are inundated by flows greater than 10,000 cfs. During the summer months flows are relatively high due to water supply releases for downstream uses. For example, under current project operations, median daily flows in August are about 6,000 cfs. During most winter months, existing impaired (i.e., operational) flows exceed estimated unimpaired flows in the lower Feather River. It is mostly during the spring runoff season that impaired flows are lower than unimpaired flows (i.e., when the reservoir is filling). Thus, the impaired flow regime does not resemble the unimpaired regime either in timing, magnitude, or duration of peak flows. This has implications for both the design and possible functioning of floodplain surfaces that might be created in the lower Feather River under this Resource Action (see discussion under Design Considerations).

Design Considerations and Evaluation:
Because of the current conditions in the lower Feather River, this Resource Action would represent a complex engineering approach to habitat creation. Creating new floodplain surfaces or benches in places with little or no topographic diversity would be potentially risky.

In such places there probably would not be sufficient material available within the channel to create new surfaces, and therefore materials would have to be imported.

Because of those issues, it would be advantageous to develop any proposals for geomorphic restoration for places that already have some desired features. At RM 34 to RM 35.5, existing point bars could be modified to improve their exposure to flooding (assuming an appropriate flow regime, see below). From RM 39 to RM 54 there is not only a relatively high degree of topographic diversity, but the substrate is gravel and levees are well set back in most locations. These areas initially seem to be places where geomorphic restoration could be feasibly undertaken without requiring levee set backs.

One additional area for geomorphic restoration would be RM 0 to RM 9. Although there is little permanent geomorphic diversity in this area (bed materials consist primarily of sand waves), the levees are set back due to Sutter Bypass. However, any proposal for this area should receive detailed study due to the inherently unstable geomorphology.

If new benches were created or floodplain surfaces modified, they would require bank protection to prevent erosion. The substrate available within the lower Feather River consists primarily of sand, silt and clay. Even at RM 39 to RM 54 or 34 to RM 35.5, the substrate is gravel or gravel and sand. Bank protection could be accomplished through the addition of rock (i.e., rip-rap) imported from outside the area or with bioengineering approaches (willow mattresses, etc).

It is assumed that the modified surfaces or benches would be constructed at elevations corresponding to different magnitudes of flow, simulating a natural floodplain setting. It is conceivable that stage-discharge relationships corresponding to unimpaired flood flows could be developed and used to design the geomorphic restoration. However, the existing flow regime does not currently resemble the unimpaired hydrograph. Therefore, EWG-19A would have to be designed in conjunction with other proposed Resource Actions to modify the existing flow regime.

If the benches and flow regime approximated a natural condition, it would probably represent a scaled-down version of the former alluvial system present in the lower Feather River. That is, it would be an alluvial system within the entrenched channel operating on an impaired natural flow regime. Although not difficult to envision, it would likely prove difficult to design as a self-regulating system. Probably the most challenging aspect would be estimating and negotiating the prescribed flow regime.

It should be noted that the IHA analysis conducted under SP-G2 provides a basis for estimating the departure of the regulated (impaired) flow regime from the natural (unimpaired) flow regime. It also provides the basis for developing a scaled-down impaired natural flow regime that would be appropriate for this Resource Action.

It is possible that side channel habitat enhancement or creation in the lower Feather River (EWG-16A and EWG-16B) could be designed in conjunction with this Resource Action. In any

event, precautions against potential fish stranding on created surfaces (or in side channels) would be required. Therefore, consideration should be given to flow ramping, as well as the discharges required to flood the benches.

The proposed Resource Action would include planting or otherwise establishing vegetation on the benches. This aspect of the Resource Action is best coordinated with EWG-17 and/or EWG-51, which deal with riparian vegetation enhancement. It is assumed that the vegetation on the benches would attempt to simulate a natural riparian successional pattern. The vegetation on different geomorphic surfaces would correspond to flood exposure. Reference conditions would be needed and these will probably be developed if a comprehensive approach to riparian vegetation enhancement and restoration is pursued. For EWG-19A, specific items to consider include erosion control, desired future riparian vegetation, control of exotics, and relationships between flow and vegetation.

The effects of the geomorphic restoration on downstream and upstream geomorphic processes would need to be evaluated. If the emphasis were on modifying surfaces that already exist, the potential effects would probably be relatively insignificant. If entirely new surfaces were created, they would change flows and geomorphic processes in an already unstable system. Therefore, the latter would probably be more risky and would likely require more detailed evaluation.

Another major issue to consider in the design of this Resource Action would be potential response to extreme peak flow events. During events of magnitudes such as the 1997 flood there could be massive erosion on the created or modified geomorphic surfaces.

Measures of effectiveness of this Resource Action could include mapping of created surfaces and associated vegetation and population surveys of targeted fish species.

Synergism and Conflicts:
Potential synergisms can be achieved by coordinating any proposals for geomorphic restoration and habitat creation with other Resource Actions involving flow management and riparian vegetation. This measure could conflict with measures to reduce bank erosion or improve navigability for recreational users.

Uncertainties:
As previously suggested, the main uncertainties with this measure are the flow regime requirements, availability of substrate for geomorphic construction, effects of geomorphic constructions on channel behavior and effects of peak flows.

Cost Estimate:
A cost estimate is not available because the potential scope of this project is unknown. However, excavation and grading of benches of floodplains will be expensive. A unit cost recently used for a similar project on the Truckee River was $12/cubic yard of excavation. Bioengineered bank protection was estimated in that project at $50/lineal foot.

In addition to construction costs, there will also be short-term maintenance costs associated with initial stabilization and re-vegetation of created surfaces. There will also be long-term maintenance and replacement costs incurred during and after peak flooding events.

Recommendations:
This is a conceptually appealing proposal but it requires much more thought if it is to be further planned and ultimately implemented. It is probably best to combine EWG-19A with EWG-22 (proposing levee setbacks) and/or EWG-16A and EWG-16B (proposing side channel creation and enhancement) and approach the question of geomorphic restoration in the lower Feather River in a more general way. Even better would be combining geomorphic restoration with riparian restoration and looking at both together. This would facilitate evaluation of alternative flow regimes that would support restoration proposals. However, even before all that, the approach to restoration needs to be clarified. Is the intention to engineer restoration or to restore processes so that the stream naturally restores itself? There are examples of both approaches to stream restoration in California and it would be instructive to learn more about what has worked (and where) before deciding on specific restoration measures.